National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers; and
National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters

Pollutants Emitted and Health Impacts
(June 9, 2010)

Introduction:

On June 9, EPA published proposed rules in the Federal Register which would reduce emissions from boilers located at area sources and boilers and process heaters located at major sources. This document highlights the pollutants emitted from these sources and the health impacts associated with the pollutants emitted.

What air pollutants will be reduced as a result of the proposed MACT standard for major source standard for boilers and process heaters and the area source standard for boilers?

These rulemakings will reduce toxic air pollutants, (also known as hazardous air pollutants) such as mercury, dioxin, and hydrogen chloride as well as common air pollutants, such as particulate matter, carbon monoxide, and sulfur dioxide.

These rules are expected to reduce 50,000 tons of particulate matter; 370,000 tons of carbon monoxide; 384,000 tons of sulfur dioxide; 37,000 tons of hydrogen chloride; 1,000 tons of hydrogen fluoride; 8.3 tons of mercury; 3,400 tons of other metals; and 1,200 grams of dioxins/furans each year from major and area sources. Additional pollutants that will be reduced by the rules are discussed in the Regulatory Impacts Analysis (RIA) for these proposed rules.

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How do the proposed rules limit these pollutants?

The proposed rule for boilers and process heaters located a major sources of air toxics would establish emission limits for:

- mercury,
- dioxin,
- hydrogen chloride

- particulate matter, and
- carbon monoxide.

The proposed rule for boilers located at area sources of air toxics would establish emission limits for:

- mercury
- particulate matter, and
- carbon monoxide

The requirements, including emission limits, that apply to a source would depend on fuel type, whether the unit is new or existing, and the size of the unit.

By reducing the emissions of these air pollutants, we also expect to reduce the emission of other toxic air pollutants even though specific emission limits for them are not proposed. For example, by imposing emission limits on particulate matter, we expect to limit the emissions of metals, such as manganese and nickel. In the same way, by imposing emission limits on carbon monoxide, we expect to reduce emissions of formaldehyde, acetaldehyde, and polycyclic aromatic hydrocarbons. By limiting the emission of hydrogen chloride we expect to also reduce emissions of hydrogen fluoride.

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How does the fuel type of the boiler or process heater affect emissions?

Although numerous air pollutants may be emitted from boilers, a few account for the majority of the total mass of air toxics emissions. See the table below for the list of the major air toxics for each fuel type (coal, gas biomass, and oil). EPA has posted on line a map of sources covered by the proposed rule for units located at major sources and their fuel types. Once you have identified the source that you are interested in, you can use the table to identify the top air toxics emitted by that type of boiler.

Top Air Toxics by Mass from Boilers by Fuel Type

Coal	Gas	Biomass	Oil
68% Hydrogen Chloride	44% Formaldehyde	32% Acetaldehyde	28% Nickel
5% Hydrogen Fluoride	25% Polycyclic Aromatic Hydrocarbons	28% Hydrogen Chloride	19% Manganese
	3% Toluene	25% Formaldehyde	

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What are the health effects of the pollutants emitted by boilers and process heaters?

Exposure to the air pollutants emitted by these sources is associated with a variety of adverse health effects. These adverse health effects include cancer and non-cancer health impacts that can affect every major system in the body, including respiratory, cardiovascular, renal, immune, reproductive, and central nervous systems. EPA considers five of the air toxics emitted by these sources to be known or probable human carcinogens (cause cancer). These are dioxin, formaldehyde, polycyclic aromatic hydrocarbons, acetaldehyde, and nickel. We do not know the extent to which the adverse health effects described above occur in the populations surrounding these facilities. However, the proposed rules would reduce emissions and subsequent exposures.

We discuss in more detail below the health effects associated with many of the pollutants that would be reduced by the proposed rules.

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Toxic Air Pollutants:

Mercury

Mercury is a naturally occurring element that is present throughout the environment, and human activity, such as burning coal, can release some of that mercury into the air, water, and soil. Mercury is a neurotoxic substance that can produce a wide range of health effects depending on the amount and timing of exposure. At high doses, mercury exposure can cause tremors, inability to walk, convulsions, and even death. At levels more commonly seen in the United States, the mercury exposure effects documented include more subtle yet serious damage to the senses and brain. Repeated exposures to low levels of mercury vapor over long periods have been associated with irritability, impulsiveness, drowsiness, impaired memory, and sleep disturbances. These effects may occur at lower levels of exposure in children than adults.

Dioxin

Dioxin is the abbreviated or short name for a family of toxic substances that all share a similar chemical structure. Dioxins have been classified by EPA as a likely human carcinogen. Because dioxins are widely distributed throughout the environment in low concentrations, most people have very low but detectable levels of dioxins in their tissues. These very low levels have accumulated over a lifetime and will persist for years, even if no additional exposure were to occur. Short-term exposure to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Developing fetuses are most sensitive to dioxin exposure. Newborns may also be more vulnerable to certain health effects.

Hydrogen Chloride

Hydrogen chloride, also called hydrochloric acid, is corrosive to eyes, skin and mucous membranes. Inhalation of higher concentrations can irritate and inflame eyes, nose and respiratory tract, as well as cause pulmonary edema. Prolonged low-level exposure can cause dental discoloration and erosion. Animal studies have shown reproductive impacts. EPA has not classified hydrogen chloride for carcinogenicity.

Hydrogen Fluoride

Short-term inhalation exposure to hydrogen fluoride can cause irritation of the eyes, nose, and upper and lower respiratory tract, sore throat, cough, chest tightness, and wheezing. Long-term exposure at low levels can also cause respiratory damage. Exposure at high levels may result in bone malformation and damage to the liver and kidneys. EPA has not classified hydrogen fluoride for carcinogenicity.

Formaldehyde

Formaldehyde is a known human carcinogen. Formaldehyde exposure also causes a range of noncancer health effects, including irritation of the eyes (burning and watering of the eyes), nose and throat. Effects from repeated exposure include respiratory tract irritation, chronic bronchitis and lesions in the nasal membranes. Also, studies suggest that formaldehyde may increase the risk of asthma—particularly for children.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. Polycyclic aromatic hydrocarbons are usually found as a mixture containing two or more of these compounds, such as in soot. Benzo(a)pyrene is the most studied of these compounds, and long-term repeated exposure to benzo(a)pyrene has been found to cause cancer.

Toluene

Short-term inhalation of toluene can affect the central nervous system, causing fatigue, sleepiness, headache, and nausea, as well as irregular heartbeat. Exposure to lower levels also causes irritation of the upper respiratory tract, eye irritation, sore throat, nausea, dizziness, headaches, and difficulty with sleep. Studies of children whose mothers were exposed to toluene or mixed solvents during pregnancy have reported attention deficits, facial and limb abnormalities, and delayed development, though these effects may not be attributable to toluene alone.

Acetaldehyde

Acetaldehyde is ubiquitous in the environment and may be formed in the body from the breakdown of ethanol. Acute (short-term) exposure to acetaldehyde results in effects including irritation of the eyes, skin, and respiratory tract. Symptoms of chronic (long-term) intoxication of acetaldehyde resemble those of alcoholism. It may also cause cancer of the upper respiratory tract.

Nickel

Nickel is a naturally occurring element. Pure nickel is a hard, silvery-white metal used to make stainless steel and other metal alloys. Respiratory effects, such as asthma, decreased lung function and bronchitis, are associated with chronic exposure to nickel in the air.

Manganese

Manganese occurs naturally in the environment. A small amount is necessary for you to stay healthy. Health effects include behavioral changes and other nervous system effects, which include movements that, with high exposures, may become slow and clumsy.

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Common Air Pollutants:

Particulate Matter

Particulate matter, also known as particle pollution, is a complex mixture of extremely small particles and liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Exposure to such particles can affect the lungs and the heart. Numerous scientific studies have linked particle pollution exposure to a variety of problems including, irritation of the airways, coughing, difficulty breathing, decreased lung function, asthma, chronic bronchitis, irregular heartbeat, and heart attacks.

Carbon Monoxide

Carbon monoxide in the surrounding air is primarily formed by the incomplete combustion of fossil-fuels and other organic (carbon-based) fuels like wood or vegetable-based oils. Carbon monoxide can also be formed by photochemical reactions in the atmosphere. Inhaled carbon monoxide goes into the bloodstream where it binds oxygen so the body cannot use it. This can cause a broad range of adverse effects throughout the body, depending on the carbon monoxide concentration and duration of exposure. Short-term exposure is linked to nervous system, cardiovascular and respiratory impacts and can result in sickness and death. Chronic long–term exposure may also cause nervous system effects, as well as developmental effects or adverse birth outcomes Especially vulnerable are the very old or developing young, diabetics, and those with preexisting pulmonary or cardiovascular disease.

Sulfur Dioxide

Short-term inhalation of sulfur dioxide can cause adverse respiratory impacts like narrowing of the airways leading to increased asthma symptoms. Sulfur dioxide can react with other compounds in the air to form small particles. These small particles penetrate deeply into the lungs and can cause or worsen respiratory disease, such as emphysema and bronchitis, and can aggravate existing heart disease.

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